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Quantifying uncertainty in sustainability assessments: from feedstock to end-of-life

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Life Cycle Assessments (LCAs) are increasingly being used to quantify the sustainability of technological solutions in decision-making contexts, for product and waste management systems. However, uncertainty in LCAs is widespread, from modelling decisions (methodological uncertainty) and data quality and appropriateness (technical uncertainty) to model representativeness of the system being studied (epistemic uncertainty) (*i.a.*, Spielmann et al., 2005). However, even if practitioners are primarily aware of uncertain inputs in their models and critical modelling choices, results are rarely accompanied with uncertainty quantifications (Laurent et al., 2014; Lloyd and Ries, 2007).

Uncertainty quantification has been addressed in the literature by many authors, mainly suggesting tiered approaches characterized by increasing levels of complexity, where the basic steps are usually contribution, sensitivity, uncertainty analyses (Clavreul et al., 2012; Heijungs et al., 2005). Yet, due to differences and the often high complexity of formulations for uncertainty propagation in the literature, as well as difficulties in representing the input uncertainty, practitioners most often relegate uncertainty quantification to an early sensitivity analysis stage, and to a technology or scenario level (Laurent et al., 2014; Lloyd and Ries, 2007).

Sensitivity represents the evaluation of the robustness of the model only, while uncertainty of parameters and processes represents the connection from the modelled system with real-life variety. Confining uncertainty quantification to sensitivity analysis or worse, propagating uncertainty just for highly sensitive parameters, may result in a severe misinterpretation of results. Moreover, the link with reality is further lost when the environmental sustainability assessments aim at quantifying emissions excluding the connection with the chemical characteristics of the material fractions constituting the feedstock. Only rarely LCA models allow input-specificity (Clavreul et al., 2014), and the importance of substances and chemicals related to the input material is most often not represented.

The presentation wants to provide a clear understanding of how uncertainty propagates in sustainability assessments, especially on the connection between sensitivity and uncertainty, with examples based on model inputs and technologies. The aim is to highlight how uncertainty quantification can help practitioners mastering the knowledge of their models and improving transparency and reliability, which are essential in the context of decision making.

References

Clavreul, J., Baumeister, H., Christensen, T.H., Damgaard, A., 2014. An environmental assessment system for environmental technologies. Environ. Model. Softw. 60, 18–30.

Clavreul, J., Guyonnet, D., Christensen, T.H., 2012. Quantifying uncertainty in LCA-modelling of waste management systems. Waste Manag. 32, 2482–2495.

Heijungs, R., Suh, S., Kleijn, R., 2005. Numerical Approaches to Life Cycle Interpretation - The case of the Ecoinvent'96 database. Int. J. Life Cycle Assess. 10, 103–112.

Laurent, A., Clavreul, J., Bernstad, A., Bakas, I., Niero, M., Gentil, E., Christensen, T.H., Hauschild, M.Z., 2014. Review of LCA studies of solid waste management systems--part II: methodological guidance for a better practice. Waste Manag. 34, 589–606.

Lloyd, S.M., Ries, R., 2007. Characterizing, Propagating and Analyzing Uncertainty in Life-Cycle Assessment. A Survey of Quantitative Approaches. J. Ind. Ecol. 11, 161–179.

Spielmann, M., Scholz, R.W., Tietje, O., Haan, P. De, 2005. Scenario Modelling in Prospective LCA of Transport Systems Application of Formative Scenario Analysis 10, 325–335.